

US EPA ARCHIVE DOCUMENT

Correction of Deepwater Horizon Acute Screening Benchmarks for Aquatic Life

Shortly after the Deepwater Horizon spill began, EPA developed some aquatic toxicity benchmarks to be used in the initial assessment of water and sediment sampling data obtained from various sampling efforts. For polycyclic aromatic hydrocarbons and some single ring compounds (e.g., benzene, toluene) these benchmarks were developed using a procedure based largely on that described in the EPA document, *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures* (EPA-600-R-02-013), with some supplementary information from papers from Di Toro et al. (2000a,b). While the values in the PAH ESB document focused on chronic effects in sediments, the technical approach used in that document calculated chronic effect concentrations for water column exposure as part of the derivation. Effect concentrations for acute exposures were also extracted from elements of the technical derivation.

More recently, a re-evaluation of the method used to derive “acute” effect benchmarks uncovered a technical error in that derivation. To develop the acute benchmarks, a procedure parallel to that used in the derivation of water quality criteria (USEPA 1985) was used to develop a “Final Acute Value”, which is conceptually the 5th percentile of a distribution of acute LC50 values within the criterion data set. This Final Acute Value was used directly to establish the acute benchmarks for water and sediments. However, this direct use of the FAV as a benchmark was in error. As clearly defined in the criteria derivation guidelines, the acute criterion (“Criterion Maximum Concentration” in the guideline document) is established as the Final Acute Value divided by 2. This division by 2 is included with the intent of reducing the severity of effect at the 5th percentile of the sensitivity distribution from a high level of effect (50% mortality) to only a limited acute effect. Accordingly, the Acute Effect Benchmarks should have been established at one-half of the values reported initially (see table below). The chronic effect benchmarks were unaffected by this error.

The impact of this error on the application of the effect benchmarks to chemical concentrations measured in the field would be relatively minor. Because the chronic effect benchmarks were unaffected, the distinction between samples above and below the chronic effect threshold would be likewise unaffected. However, there would be some samples that were listed as being above the chronic benchmark but below the acute benchmark than might have been more appropriately designated as exceeding the acute benchmark.

References:

Di Toro, D. M., McGrath, J. A., and Hansen, D. J. 2000a. Technical basis for narcotic chemicals and polycyclic aromatic hydrocarbon criteria. I. Water and tissue. *Environmental Toxicology and Chemistry*, 19(8), 1951-1970.

Di Toro, D. M., and McGrath, J. A. 2000b. Technical basis for narcotic chemicals and polycyclic aromatic hydrocarbon criteria. II. Mixtures and sediments. *Environmental Toxicology and Chemistry*, 19(8), 1971-1982.

U.S. Environmental Protection Agency (USEPA). 1985. Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses. PB85-227049. U.S. EPA:Washington, DC.

Original and revised Acute Potency Divisors for PAHs and single ring compounds

CHEMICAL	Water Column Original 2010 Acute Potency Divisor (ug/L)	Water Column Corrected Acute Potency Divisor (ug/L)	Sediment Original 2010 Acute Potency Divisor (µg/g OC)	Sediment Corrected Acute Potency Divisor (µg/g OC)
Benzene	27,000	13,500	3,360,000	1,680,000
Cyclohexane	1,900	950	4,000,000	2,000,000
Ethylbenzene	4,020	2,010	4,930,000	2,465,000
Isopropylbenzene	2,140	1,070	5,750,000	2,875,000
m-Xylene	3,560	1,780	4,980,000	2,490,000
p-Xylene	3,560	1,780	4,980,000	2,490,000
o-Xylene	3,560	1,780	4,980,000	2,490,000
Methylcyclohexane	463	231	4,960,000	2,480,000
Toluene	8,140	4,070	4,120,000	2,060,000
Naphthalene	803	402	1,600,000	800,000
C1-Naphthalenes	340	170	1,850,000	925,000
C2-Naphthalenes	126	63	2,120,000	1,060,000
C3-Naphthalenes	46.1	23.1	2,420,000	1,210,000
C4-Naphthalenes	16.9	8.4	2,730,000	1,365,000
Acenaphthylene	1,280	640.0	1,880,000	940,000
Acenaphthene	232	116.1	2,040,000	1,020,000
Fluorene	164	81.8	2,240,000	1,120,000
C1-Fluorenes	58.1	29.1	2,540,000	1,270,000
C2-Fluorenes	22.0	11.0	2,850,000	1,425,000
C3-Fluorenes	7.99	4.0	3,200,000	1,600,000
Phenanthrene	79.7	39.8	2,480,000	1,240,000
Anthracene	86.1	43.1	2,470,000	1,235,000
C1-Phenanthrenes	31.0	15.5	2,790,000	1,395,000
C2-Phenanthrenes	13.3	6.65	3,100,000	1,550,000
C3-Phenanthrenes	5.24	2.62	3,450,000	1,725,000
C4-Phenanthrenes	2.33	1.16	3,790,000	1,895,000
Fluoranthene	29.6	14.8	2,940,000	1,470,000
Pyrene	42.0	21.0	2,900,000	1,450,000
C1-pyrene/fluoranthenes	20.3	10.2	3,200,000	1,600,000
Benz(a)anthracene	9.28	4.64	3,500,000	1,750,000
Chrysene	8.49	4.24	3,510,000	1,755,000
C1-Chrysenes	3.56	1.78	3,870,000	1,935,000
C2-Chrysenes	2.01	1.00	4,200,000	2,100,000
C3-Chrysenes	0.699	0.35	4,620,000	2,310,000
C4-Chrysenes	0.294	0.15	5,030,000	2,515,000
Perylene	3.75	1.87	4,020,000	2,010,000
Benzo(b)fluoranthene	2.82	1.41	4,070,000	2,035,000
Benzo(k)fluoranthene	2.67	1.34	4,080,000	2,040,000
Benzo(e)pyrene	3.75	1.87	4,020,000	2,010,000
Benzo(a)pyrene	3.98	1.99	4,020,000	2,010,000
Indeno(1,2,3-cd)pyrene	1.14	0.57	4,620,000	2,310,000
Dibenz(a,h) anthracene	1.17	0.59	4,660,000	2,330,000
Benzo(g,h,i)perylene	1.83	0.91	4,540,000	2,270,000